

Takayuki SHUKU (珠玖 隆行)

Office Address: 3-1-1 Tsushima naka, Kita-ku, Okayama, 700-8530, Japan

Tel: +81-086-251-8161, **Fax:** +81-086-251-8881

Email: shuku@cc.okayama-u.ac.jp

Website: <https://sites.google.com/view/takayukishukuswebsite/home>



Machine Learning in Geotechnical Engineering



MUSIC and basic science or technical data



Education

Oct. 2008 - Sep. 2011

D. Env., Graduate School of Environmental Science, Okayama University, Japan.

Apr. 2005 - Mar. 2007

M.Sci. Eng., Graduate School of Science and Engineering, Shimane University, Japan.

April. 2001 - Mar. 2005

B.Sci. Eng., Department of Earth Science, Shimane University, Japan

Research: Machine Learning in Geotechnical Engineering

In geotechnical engineering, data are usually uncertain/unique, sparse, Incomplete, and potentially corrupted (referred to as “MUSIC” characteristics).

Some machine learning methods can not directly be applied to geotechnical problems because they usually assume that the data are “clean” and do not have such “MUSIC” characteristics.

Our group develops machine learning methods to deal with obstacles resulting from the “MUSIC” characteristics. Those methods are applied to geotechnical approaches for safe design and construction.

Positions: Japan

Oct. 2016 - Present

Associate Professor, Graduate School of Environmental and Life Science, Okayama University, Japan

Oct. 2011 - Sep. 2016

Assistant Professor, Graduate School of Environmental and Life Science, Okayama University, Japan

Apr. 2007 - Sep. 2011

Design Engineer, Department of Civil Engineering Design, Ohmoto Gumi Co., Ltd.



International positions

Dec.2019 - Nov. 2020

Visiting Scholar, Department of Civil and Environmental Engineering,
National University of Singapore, Singapore
Supervisor: Prof. K.K. Phoon



“Chicken rice” in Singapore

Aug. 2017 - Sep 2017

Visiting Scholar, Fresh Water Center (Jyväskylä Office), Finish Environment Institute, Finland
Supervisor: Prof. Timo Huttula



At Bochum with Colleagues

Feb. 2016 - Mar. 2016

Visiting Scholar, Faculty of Civil and Environmental Engineering, Ruhr University Bochum, Germany
Supervisor: Prof-Ing. Tom Schanz



In Finland with Timo and Timo's wife (Leena)

Teaching

- Linear Algebra
- Data Science (Advanced)
- Structural Mechanics (Advanced)
- Structural Mechanics (Advanced)
- Computer Language
- Basics of Engineering Experiment
- Geotechnical Experiment
- Geotechnical Design (for Graduates)



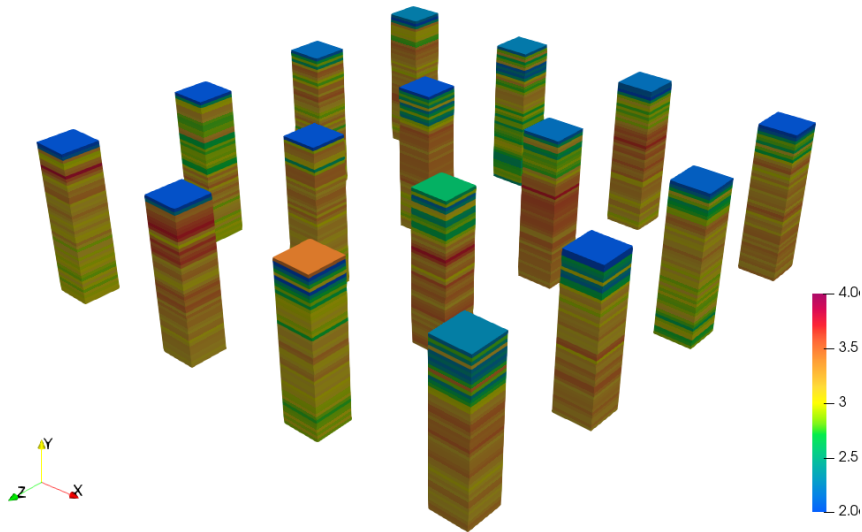
A talk at Ruhr University

A talk at Ho Chi Minh City University



Research Topic: Data-driven Subsurface Modeling for Safe Geotechnical Design

Collaboration with National University of Singapore



Sparse & incomplete geotechnical data

References:

T. Shuku, K.K. Phoon, I. Yoshida: Trend estimation and layer boundary detection in depth-dependent soil data using sparse Bayesian lasso, *Computers and Geotechnics*, 128 (2020) 103845.

T. Shuku and K.K. Phoon: Three-dimensional subsurface modeling using Geotechnical Lasso, *Computers and Geotechnics*, 133 (2021) 1034068

K.K. Phoon, J. Ching and T. Shuku: Challenges in data-driven site characterization, *Georisk: Assessment and Management of Risk for Engineered Systems and Geohazards*, DOI: 10.1080/17499518.2021.1896005.

Sparse Modeling

$$J = \frac{1}{2} (\mathbf{y} - \mathbf{A}\mathbf{x})^T (\mathbf{y} - \mathbf{A}\mathbf{x}) + \lambda_v \left[\begin{array}{c} \mathbf{B}_v \\ \lambda_h / \lambda_v \mathbf{B}_h \\ \lambda_{vh} / \lambda_v \mathbf{B}_{vh} \end{array} \right] \mathbf{x}$$

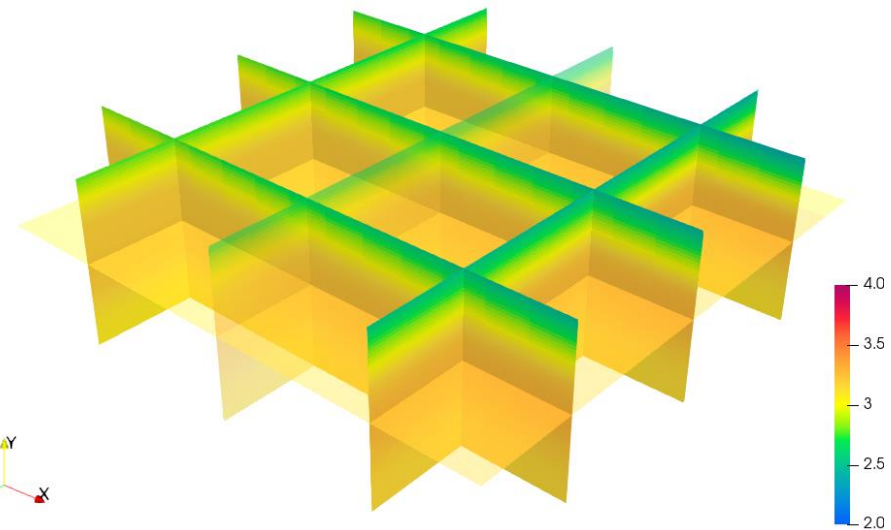
\mathbf{y} : Observation

\mathbf{A} : Design matrix

\mathbf{x} : Unknown parameters

\mathbf{B} : Total variation matrix

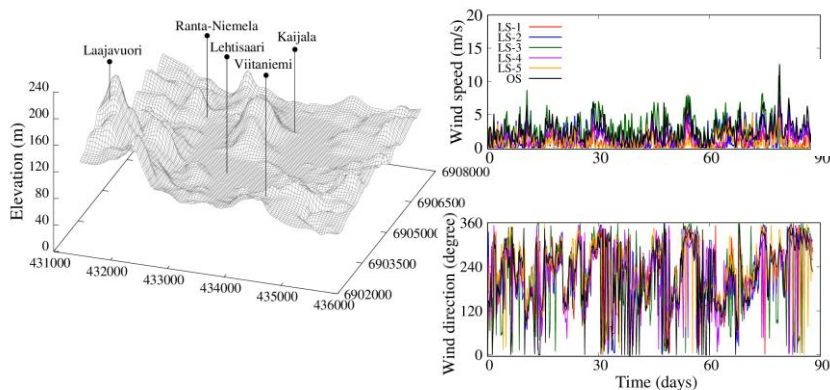
λ : Regularization parameter



Reconstructed 3D image

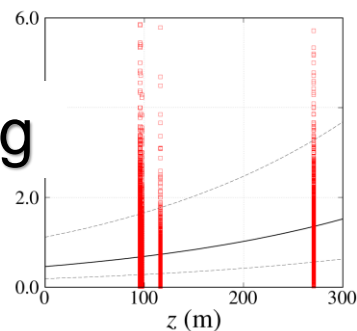
Research Topic: Data-driven wind field modelling for Environmental Management

Collaboration with Tohoku University and Finish Environmental Institute (SYKE)

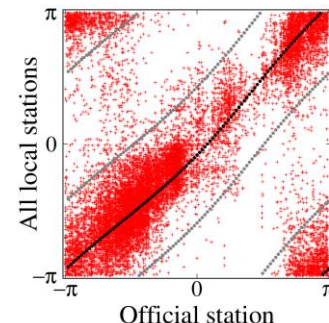


Spatially Sparse Data

Modelling

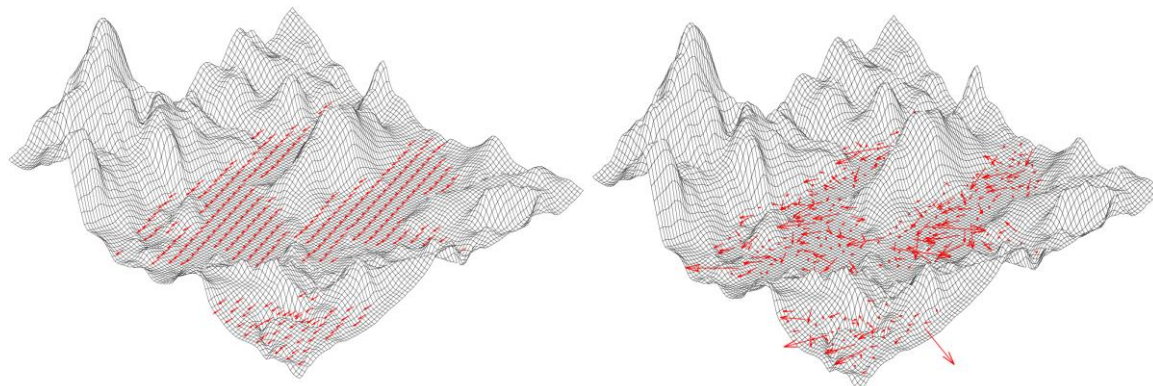


Wind speed model



Wind direction model

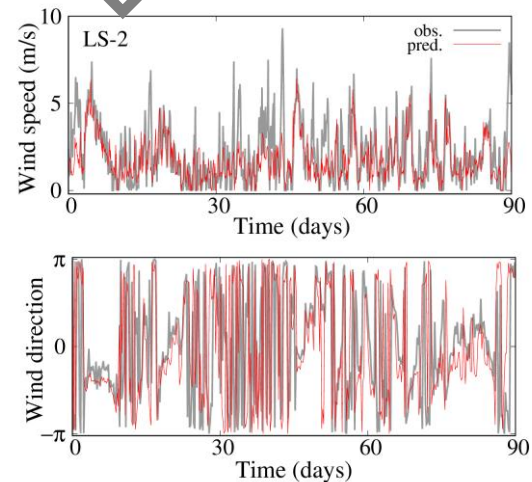
Application



Homogeneous wind field

Heterogeneous wind field

Spatial-temporal wind field modeling



J. Juntunen, J. Ropponen, T. Shuku, K. Krogerus, T. Huttula: The effect of local wind field on water circulation and dispersion of imaginary tracers in two small connected lakes, *Journal of Hydrology*, 679, 2019.

My Group



Hanami (花見) Party



Welcome Party



Farewell Party



Marathon



UNIVERSITÉ DE STRASBOURG



Awards

2020

Best Paper Award (Japan Society of Civil Engineering)

2019

Bright Spark Lecture Award

The award for among the top five downloaded articles in Granular Matter during 2018

2018

Best Paper Award, Chugoku Branch of the Japanese Geotechnical Society

2013

Excellent Presentation Award at the 48th Japan National Conference on Geotechnical Engineering

Best Paper Award, Japanese Geotechnical Society

Young Researcher Award, Japanese Geotechnical Society

2012

Incentive award at the 67nd Chugoku-Shikoku regional conference on Irrigation, drainage and rural engineering

2011

Excellent Presentation Award at the 46th Japan National Conference on Geotechnical Engineering

2009

Excellent Presentation Award at the 44th Japan National Conference on Geotechnical Engineering



Publications

2021

K.K. Phoon, J. Ching and T. Shuku: Challenges in data-driven site characterization, *Georisk: Assessment and Management of Risk for Engineered Systems and Geohazards*, DOI: 10.1080/17499518.2021.1896005.

T. Shuku and K.K. Phoon: Three-dimensional subsurface modeling using Geotechnical Lasso, *Computers and Geotechnics*, 133 (2021) 1034068.

2020

T. Shuku, K.K. Phoon, I. Yoshida: Trend estimation and layer boundary detection in depth-dependent soil data using sparse Bayesian lasso, *Computers and Geotechnics*, 128 (2020) 103845.

Y. Ikumasa and T. Shuku: Bayesian Updating of Model Parameters by Iterative Particle Filter with Importance Sampling, *ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng.*, 6(2): 04020007, 2020.

2019

J. Juntunen, J. Ropponen, T. Shuku, K. Krogerus, T. Huttula: The effect of local wind field on water circulation and dispersion of imaginary tracers in two small connected lakes, *Journal of Hydrology*, 679, 2019.

D. Ousaka, N. Sakano, M. Morita, T. Shuku, K. Sanou, S. Kasahara, S. Oozawa: A new approach to prevent critical cardiac accidents in athletes by real-time electrocardiographic tele-monitoring system: Initial trial in full marathon, *J. Cardiol. Cases*, 20(1), 35-38, 2019.

T. Shibata, T. Shuku, A. Murakami, S. Nishimura, K. Fujisawa, N. Haegawa, S. Nonami: Prediction of long-term settlement and evaluation of pore water pressure using particle filter, *Soils and Foundations*, 59(1), 67-83, 2019.

H. Cheng, T. Shuku, K. Thoeni, P. Tempone, S. Luding and V. Magnanimo: An iterative Bayesian filtering framework for fast and automated calibration of DEM models, *Computer Methods in Applied Mechanics and Engineering*, 350, 268-294, 2019.

H. Cheng, T. Shuku, K. Thoeni and H. Yamamoto: Probabilistic calibration of discrete element simulations using the sequential quasi-Monte Carlo filter, *Granular Matter*, 20: 11, 2018.

